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Dated 17 October 2006

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Patents Form 1/77

Patents Act 1977
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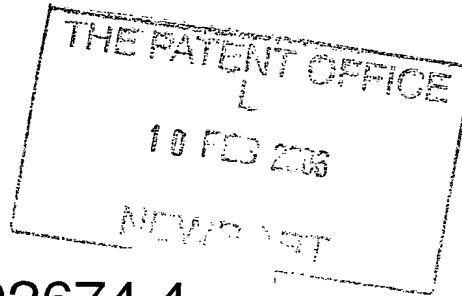
1/77

10 FEB 2006

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Request for grant of a patent

(An explanatory leaflet on how to fill in this form is available from the Patent Office)



Application number GB

0602674.4

J171277/ 001 D02461 P01/TTFEE.....
10FEB06 30.00 ACCOUNT 0602674.4

- 1 Your reference:
(optional)
- 2 Full name, address and postcode of the applicant
or of each applicant (underline all surnames):

205-1610GB

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United States of America

8600957003

Patents ADP number (*if you know it*):

If the applicant is a corporate body, give the
country/state of its incorporation:

United States of America/Delaware

- 3 Title of the invention:
- 4 Name of your agent (*if you have one*):

A Motor Vehicle

David Grunfeld

"Address for service" in the United Kingdom
to which all correspondence should be sent
(*including the postcode*)

Ford Motor Company Limited
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Patents ADP number (*if you know it*):

6826747002

- | | Country | Application number
(<i>if you know it</i>) | Date of filing
(<i>day/month/year</i>) |
|---|---|---|---|
| 5 | Priority declaration: Are you claiming
priority from one or more earlier-filed
patent applications? If so, please give
details of the application(s): | | |
| 6 | Divisionals etc: Is this application a divisional
application, or being made following resolution
of an entitlement dispute about an earlier
application? If so, please give the application
number and filing date of the earlier application: | | |

Number of earlier
UK application

Date of filing
(*day/month/year*)

7 Inventorship: (Inventors must be individuals not companies) (Please tick the appropriate boxes)

Are all the applicants named above also inventors?

YES

☐

NO

☒

If yes, are there any other inventors?

YES

☐

NO

☐

8 Are you paying the application fee with this form?

YES

☒

NO

☐

9 Accompanying documents: not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form:

Description: 9

Claim(s): 2

Abstract: 1

Drawing(s): 1

If you are not filing a description, please give details of the previous application you are going to rely upon:

Country

Application Number

Date of filing
(day/month/year)

10 If you are also filing any of the following, state how many against each item.

Priority documents:

Statement of inventorship and right to grant of a patent (Patents Form 7/77): 5

Request for search (Patents Form 9A/77): 1

Request for substantive examination
(Patents Form 10/77):

Any other documents: 1 Fee Sheet (FS2)
(please specify)

11 I/We request the grant of a patent on the basis of this application.

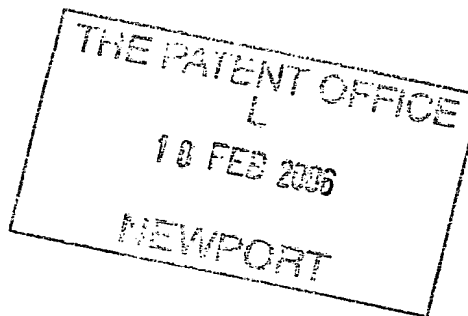
Signature(s): *Marion Gillespie* Date: *2nd February 2006*

12 Name, e-mail address, telephone, fax and/or mobile number, if any, of a contact point for the applicant: Marion Gillespie
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Patents Form 7/77

Patents Act 1977
(Rule 15)



7/77

The Patent Office
Cardiff Road
Newport
South Wales
NP10 8QQ

Statement of inventorship and of right to grant of a patent

- 1 Your reference: 205-1610GB
- 2 Patent application number:
(if you know it) 0602674.4
- 3 Full name of the or of each applicant: Ford Global Technologies, LLC

10 FEB 2006

- 4 Title of the invention: A Motor Vehicle
- 5 State how the applicant(s) derived the right from the inventor(s) to be granted a patent:

By virtue of agreements giving rights to inventions made by the employer of the inventors

- 6 How many, if any, additional Patents Forms 7/77 are attached to this form?
(see note (c)): 1

- 7 I/We believe that the person(s) named over the page (and on any extra copies of this form) is/are the inventor(s) of the invention which the above patent application relates to.

Signature

Date

2nd February 2006

- 8 Name and daytime telephone number of person to contact in the United Kingdom:

David Grunfeld Tel: 01277 253107

Notes

- a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- b) Write your answers in capital letters using black ink or you may type them.
- c) If there are more than three inventors, please write the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.
- d) When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.
- e) Once you have filled in the form you must remember to sign and date it.

Patents Form 7/77

Enter the full names, addresses and postcodes of the Inventors in the boxes and underline the surnames

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Reminder

Have you signed the form?

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Patents ADP number (if you know it)

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205-1610GB

- 1 -

A Motor Vehicle

This invention relates to motor vehicles and in particular to the control of an internal engine for a motor
5 vehicle.

It is known to automatically control the stopping and starting of an internal combustion engine for a motor vehicle so as to reduce emissions from the engine and to
10 improve fuel economy. Such vehicles are often referred to as "micro-hybrids" because like a true hybrid vehicle they are able to selectively stop the internal combustion engine but unlike a full hybrid no alternative motive power source is provided and so the internal combustion engine can only
15 be stopped when the motor vehicle does not require motive power such as when it is stationary.

It is a problem, particularly with micro-hybrid vehicles but also in some circumstances with hybrid
20 vehicles, that the internal combustion engine has to be kept running when it could otherwise be stopped, because the engine is used to drive not only the motor vehicle but also various ancillary devices such as a water circulation pump to pump water through a cooling system for the engine, a
25 power steering pump and an air-conditioning compressor. If one of these ancillary devices must remain operating then the engine cannot be stopped even if it might otherwise be appropriate to do so. For example the air-conditioning compressor may be required to be kept running to cool a
30 passenger compartment of the motor vehicle or the water circulation pump may be required to be kept running to prevent boiling of the coolant in the engine.

It is an object of this invention to provide a motor
35 vehicle having an engine that can be automatically stopped when required irrespective of the requirements of any ancillary device driven by the engine.

According to a first aspect of the invention there is provided a motor vehicle having an internal combustion engine, an ancillary drive to driveably connect one or more ancillary devices to an output from the engine, a
5 disengageable connection interposed between the output from the engine and the ancillary drive to permit the ancillary drive to be disengaged from the engine and a controller to control the disengageable connection wherein, when at least
10 one vehicle operating condition is met, the disengageable connection is disengaged and a source of motive power driveably connected to the ancillary drive is energised to drive the one or more ancillary devices.

15 The at least one vehicle operating condition may be a condition indicating that the engine can be temporarily stopped.

The at least one vehicle operating condition may be a
20 condition indicating that a high power output is required from the engine.

The disengageable connection may be a clutch controlled by the controller.

25 The source of motive power may be an electric machine.

One of the one or more ancillary devices driveably connected to the engine by the ancillary drive may be the
30 electric machine.

The electric machine may be a motor/generator.

The motor/generator may be an integrated starter
35 generator used to start the engine.

The one or more ancillary devices may comprise at least one of a power assisted steering pump, an air-conditioning compressor, an engine coolant pump and an electrical generator.

5

The output from the engine may be a crankshaft of the engine.

10 The controller may be part of a control system used to control operation of the engine and to energise the source of motive power.

The invention will now be described by way of example with reference to the accompanying drawing of which:-

15

Fig.1 is a schematic front view of an engine forming part of a motor vehicle according to the invention; and

Fig.2 is a plan view of the engine shown in Fig.1.

20

With references to Figs.1 and 2 there is shown a motor vehicle 5 having an internal combustion engine 10 used to provide motive power to the motor vehicle 5. The engine 10 is controlled by an engine control system (not shown) which includes a facility to automatically stop and start the engine 10 when one or more predetermined vehicle operating conditions are met. For example, if the motor vehicle 5 is sensed to be stationary and an accelerator pedal used to provide a driver input is not depressed for a pre-determined period of time then this may constitute a vehicle operating condition indicating that the engine 10 can be temporarily stopped. If the accelerator pedal is then subsequently depressed, this can be used as a vehicle operating condition to indicate that the engine 10 must be restarted. It will be appreciated that numerous vehicle operating conditions could be used to indicate that the engine 10 can be

35

temporarily stopped or restarted and the invention is not limited to those described herein.

The engine 10 is driveably connected via a
5 disengageable connection 21 to an ancillary drive which in this case is in the form of a continuous belt 11 but could also be a chain drive or a gear drive.

The disengageable connection is formed by a clutch 21
10 which is connected on an input side to an output from the engine 10 in the form of a crankshaft of the engine 10 and on an output side to a main or crank pulley 22 used to transmit drive to the belt 11. The term 'clutch' as meant
15 herein includes devices that permit relative rotation between input and output side of the clutch during disengagement and re-engagement such as a friction clutch or wet clutch and devices that provide only full engagement or full disengagement such as a dog clutch.

20 The ancillary drive in this case drives four ancillary devices in the form of a motor/generator 12, an air-conditioning compressor 14, a power steering pump 16 and a coolant pump 18.

25 The motor/generator 12 is driven by the belt 11 via a pulley 13 which is drivingly engaged with the belt 11 and in this case the motor/generator is an integrated starter/generator 12 which is used to not only generate electricity to charge an electrical storage device such as a battery
30 (not shown) but is also used to start the engine 10.

The air-conditioning compressor 14 is driven by the belt 11 via a pulley 15 which is drivingly engaged with the belt 11, the power steering pump 16 is driven by the belt 11
35 via a pulley 17 which is drivingly engaged with the belt 11 and the coolant pump 18 is driven by the belt 11 via a pulley 19 which is drivingly engaged with the belt 11. A

belt tensioner pulley 23 is provided to maintain sufficient tension in the belt 11 to prevent slippage. It will be appreciated that other belt tensioning means could be used.

5 The clutch 21 is electronically controlled by a controller 20 which forms part of the engine control system and may, as shown, be a separate unit or may be incorporated as part of a larger controller used to control stop/start operation of the engine 10. In either case when the
10 controller 20 receives a signal indicating that the engine 10 is to be temporarily stopped and, in response to that signal, disengages the clutch 21 so that the belt 11 is no longer driven by the output from the engine 10.

15 At the same time as the clutch 21 is disengaged, the motor/generator 12 is energised to drive the belt 11 and thereby drive the other ancillary devices 14, 16 and 18 so as to keep them operating even though the engine 10 has been stopped. This means that irrespective of the demands placed
20 upon the ancillary devices 14, 16 and 18, the engine 10 can be temporarily stopped so as to reduce emissions and increase fuel economy without regard to the demands placed upon the ancillary devices 14, 16 and 18.

25 Although the source of motive power used to drive the belt 11 when the clutch is disengaged is, in this case, one of the ancillary devices normally driven by the belt when the clutch 21 is engaged, this need not be the case and a separate electric motor or other form of motive power such
30 as a hydraulic motor or steam powered turbine/motor could be used for this purpose.

 If, as in this case, an electric motor is used for the source of motive power then the state of charge or energy
35 level of the source of electrical power for the electric motor is monitored to ensure that it does not drop below a safe level below which restarting of the engine 10 could be

a problem. If the energy stored in the source of electrical energy drops to the safe level then the engine 10 will be automatically restarted and the clutch 21 engaged so that the motor/generator 12 can be driven as a generator by the belt 11 to replenish the stored electrical energy and return it to a safe level. However, due to the fact that the engine 10 is only normally stopped for a short period this will rarely be necessary provided a source of electrical energy of sufficient capacity is provided on the motor vehicle 5.

The motor/generator 12 is energised to drive the belt 11 by an electronic controller which is connected to or forms part of the engine control system. The motor/generator 12 is energised when a signal is received by the motor/generator controller indicating that drive is required to maintain operation of the other ancillary devices 14, 16 and 18. This signal can be sent from the controller 20 used to control operation of the clutch 21 or can be derived from the same source used by the controller 20 to indicate that disengagement of the clutch 21 is required.

When it is determined that the engine 10 needs to be restarted a signal is sent to the controller 20 indicating that the clutch 21 must be engaged and the controller used to control the operation of the motor/generator 12 receives a signal indicating that the use of the motor/generator 12 as a source of motive power to drive the belt 11 is no longer required. If the motor/generator 12 is, as described, an integrated starter generator then the motor/generator 12 is kept operating as a motor until the engine 10 is sensed to be running at which point it is switched to operation as a generator but if a separate means is used to start the engine 10 then the motor/generator 12 is switched to operation as a generator simultaneously with the engaging of the clutch 21.

It will be appreciated that although the engine 10 as previously described is the engine of a micro-hybrid vehicle the invention could also be applied to any other type of hybrid vehicle such as a full hybrid or mild hybrid where the motor is only sufficient for launch assist.

It will be appreciated that more or less ancillary devices could be driven by the belt 11 than those shown.

Although the invention has so far been described with respect to its advantageous use in permitting more frequent temporary stopping of the engine 10 in order to maximise fuel economy and reduce emissions it can also be used to improve the performance of the motor vehicle 5 as described hereinafter.

The load placed upon an engine by the ancillary devices driven by the engine can be considerable and depending upon the ancillary devices provided and the operating state of each ancillary device can vary from a few kilowatts to several tens of kilowatts. Although this load is not unduly significant to the performance of a motor vehicle fitted with a high powered engine producing more than 100 kilowatts it is very significant to a motor vehicle having a low power engine producing only 25 to 50 kilowatts.

By using the clutch 21 to disengage the ancillary devices from the engine 10 when a high power output is required from the engine 10 a significant improvement in motor vehicle acceleration or climbing ability can be obtained.

In this case the controller 20 is operable to disengage the clutch 21 when a vehicle operating condition indicating that a high power output is required from the engine 10 is received. The vehicle operating condition can be, amongst

others, an indication that an accelerator pedal has been depressed more than a predetermined amount, that a driver controlled device such as a switch has been operated or a signal from the engine control system that maximum engine power is required, as may be the case when the motor vehicle is climbing a hill and is unable to maintain the current forward speed.

It will be appreciated that such an additional power output can only be supplied for a short period of time if an electric machine is used to power the ancillary devices because of the need to maintain a safe energy limit in the electrical storage device used to power the electric machine. However, this may not be the case if a steam powered device is used if the steam is produced from excess heat generated by the engine 10.

When the conditions demanding a power boost no longer exist or a power boost can no longer be provided the clutch 21 is automatically re-engaged so that the engine 10 once more drives the ancillary devices 12, 14, 16 and 18.

An indicator device such as a light or instrument display may be provided to a user of the motor vehicle to indicate when a power boost is possible and may further indicate when a power boost is to be automatically terminated. For example a green light may be illuminated to indicate that a power boost is possible, a red light to indicate that a power boost is not possible and the green light may start to flash with the red light when a power boost is to be automatically terminated.

It will be appreciated that such a power boost arrangement could be used on any motor vehicle powered by an internal combustion engine and is not limited to use on low power motor vehicles, micro-hybrid vehicles or full hybrid vehicles. However the provision of power boost is

particularly advantageous in the case of a micro-hybrid or
hybrid vehicle also using the clutch 21 for improved stop
start operation as virtually no additional hardware is
required only an additional control signal to the controller
5 20.

It will be appreciated by those skilled in the art that
although the invention has been described by way of example
with reference to one or more embodiments it is not limited
10 to the disclosed embodiments and that modifications to the
disclosed embodiment or alternative embodiments could be
constructed without departing from the scope of the
invention.

1. A motor vehicle having an internal combustion engine, an ancillary drive to driveably connect one or more ancillary devices to an output from the engine, a
5 disengageable connection interposed between the output from the engine and the ancillary drive to permit the ancillary drive to be disengaged from the engine and a controller to control the disengageable connection wherein, when at least
10 one vehicle operating condition is met, the disengageable connection is disengaged and a source of motive power driveably connected to the ancillary drive is energised to drive the one or more ancillary devices.

15 2. A motor vehicle as claimed in claim 1 wherein the at least one vehicle operating condition is a condition indicating that the engine can be temporarily stopped.

3. A motor vehicle as claimed in claim 1 or in claim
20 2 wherein the at least one vehicle operating condition is a condition indicating that a high power output is required from the engine.

4. A motor vehicle as claimed in any of claims 1 to 3
25 wherein the disengageable connection is a clutch controlled by the controller.

5. A motor vehicle as claimed in any of claims 1 to 4
30 wherein the source of motive power is an electric machine.

6. A motor vehicle as claimed in claim 5 wherein one of the one or more ancillary devices driveably connected to the engine by the ancillary drive is the electric machine.

35 7. A motor vehicle as claimed in claim 5 or in claim 6 wherein the electric machine is a motor/generator.

8. A motor vehicle as claimed in claim 7 wherein the motor/generator is an integrated starter generator used to start the engine.

5 9. A motor vehicle as claimed in any of claims 1 to 8 wherein the one or more ancillary devices comprises at least one of a power assisted steering pump, an air-conditioning compressor, an engine coolant pump and an electrical generator.

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10. A motor vehicle as claimed in any of claims 1 to 9 wherein the output from the engine is a crankshaft of the engine.

15

11. A motor vehicle as claimed in any of claims 1 to 10 wherein the controller is part of a control system used to control operation of the engine and to energise the source of motive power.

20

12. A motor vehicle substantially as described herein with reference to the accompanying drawing.

A Motor Vehicle

5 A motor vehicle 5 is disclosed having an engine 10 used
to drive a number of ancillary devices 12, 14, 16 and 18 via
an ancillary drive 11. An electronically controlled
disengageable connection 21 is provided to selectively
disengage the drive from the engine 10 to the ancillary
10 drive 11. When the ancillary drive 11 is disengaged a
source of motive power 12 is used to power the ancillary
devices 14, 16 and 18 so as to maintain their operation.

15

20

Fig.1

1/1

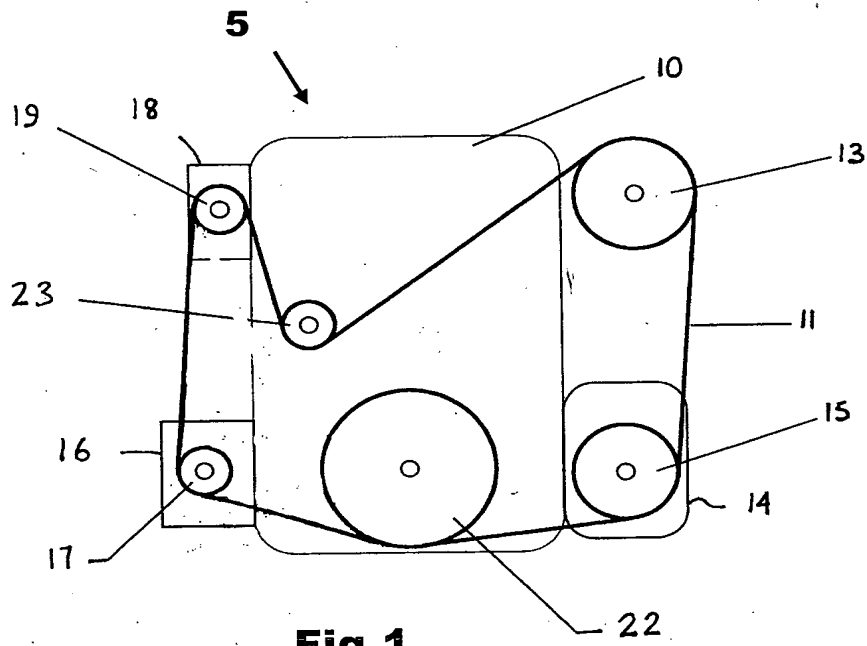


Fig.1

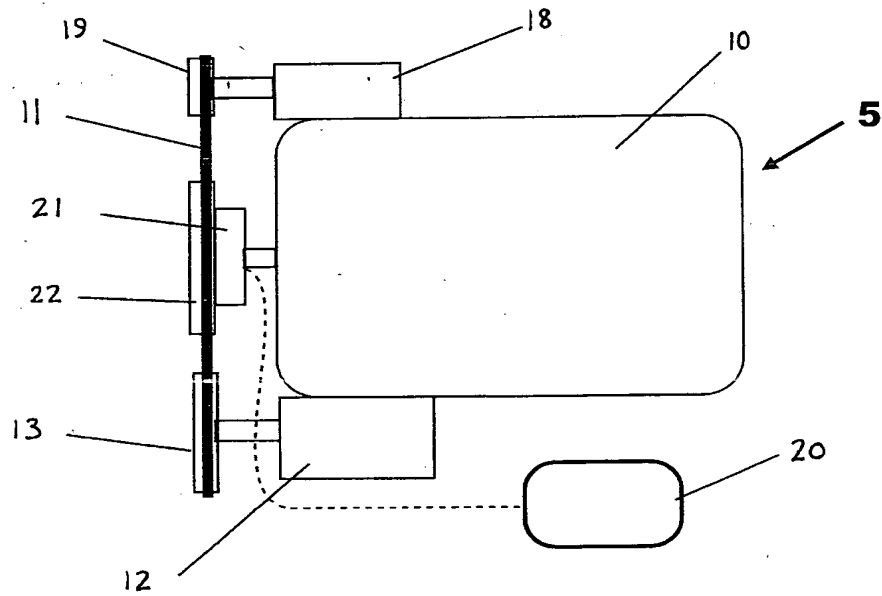


Fig.2

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